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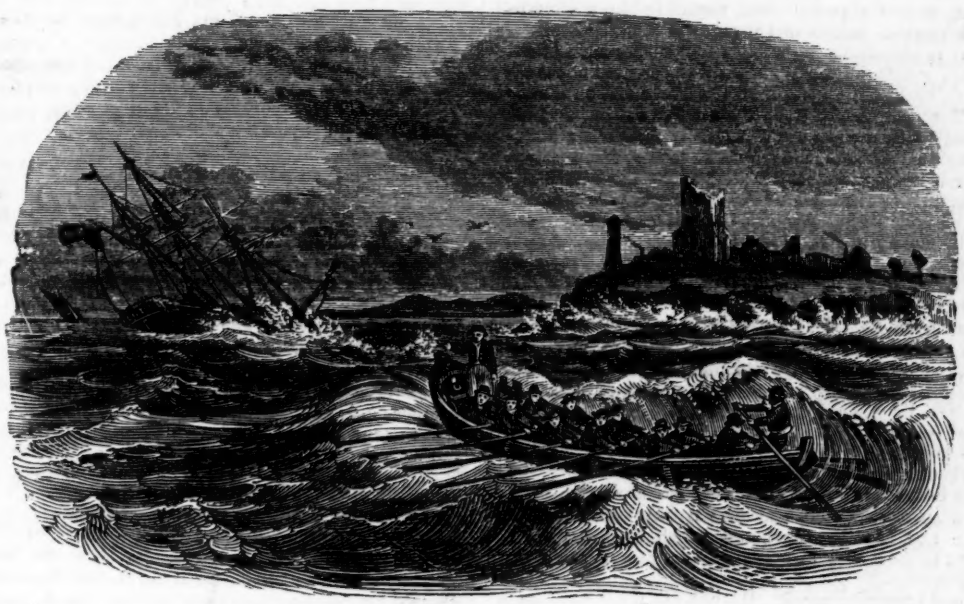
A BRIEF HISTORY OF NAVIGATION. PART V.



A LIFE-BOAT GOING TO THE ASSISTANCE OF A SHIP IN DISTRESS.

MODERN NAVIGATION.

Now, while on high the freshening gale she feels,
The ship beneath her lofty pressure reels.
The auxiliar sails, that court a gentle breeze,
From their high stations sink by slow degrees.
The watchful ruler of the helm no more
With fixed attention eyes the adjacent shore;
But by the oracle of truth below,
The wondrous magnet, guides the wayward prow.
The wind, that still the impressive canvass swelled,
Swift and more swift the yielding bark impelled.

A SHORT SKETCH OF THE PRINCIPAL VOYAGES PERFORMED IN MODERN TIMES.

In the preceding divisions of the subject, we have endeavoured to give a general view of the progress of naval enterprise down to about the year 1500. That memorable period formed a marked and most eventful epoch in the history of the human race. The invention of printing, and the important circumstances connected with the Reformation, separated what may indeed be termed the "dark ages" from modern times; and a third class of events, which served to make that boundary still more decisive, was the discovery of lands before unknown to the nations of Western Europe.

The progress of these discoveries we shall now give a general sketch of, without entering into any details. This is all that our limits allow of: further information must be sought in works which are devoted to the narration of single voyages, each of which voyages often furnishes matter for volumes.

In 1497 Sebastian Cabot discovered the main-land of America itself, near Newfoundland. This person received a royal commission from Henry the Seventh, to discover new countries, and trade therein. He seems to have been of English origin, but brought up at Venice, which having left, he lived for some time at Bristol. The English had been induced to send Cabot out, from jealousy of Spain and Portugal, which countries had thriven by pursuing the American trade. Not but that opposition to the Pope had some influence on English adventure; the Pope having been very free in giving away the New World to the inhabitants of the Peninsula. The English set out, however, without such patronage.

About fourteen years after this event, some adventurers in London endeavoured to seek out a passage to Cathay (the modern India) and China, by sailing to the north-west. About the year 1499 took place the voyage of Vicente Yanez Pinzon, one of the earliest companions of Columbus. In sailing to the south-west, over the Atlantic Ocean, he met with a violent tempest which forced him upon the coast of Brazil, the people of which coasts took the boats for the young of the ships. They were alarmed by the depression of the pole-star, and astonished and excited at the sight of the constellation called the CROSS. Here they discovered the mighty river Maranon, now called the river of Amazons, from the notion that some early travellers had asserted that they saw armed women roaming about upon its banks. The water of this river makes the sea fresh for many leagues from the shore.

In the year 1513 Balboa, a Spanish navigator, first crossed the Isthmus of Darien, which joins North and South America, and saw the vast Pacific ocean rolling beneath him; and in 1520 Magellan, a Portuguese, who had the command of a Spanish expedition, sailed towards the South Seas, and explored the southern part of the American continent. The land separated by the Straits of Magellan he named *Tierra del Fuego*, or *land of fires*, from the vast number of fires seen during the night in this country.

The strait named after himself being passed through, Magellan saw the South Pacific ocean before him. This voyage of Magellan was attended by many important results. It showed that the Pacific and Atlantic oceans were united, and likewise ascertained the boundary of the

American continent. Magellan was unfortunately killed at the Philippine islands; but his companions in the Vittoria sailed on to the Moluccas, where they astonished the Portuguese by their presence. They then sailed on to Europe, and arrived at Lisbon, after a voyage of three years, which time they had taken up in sailing round the earth: so that the fact of the earth being a globe could never after be doubted.

In 1501 Amerigo Vespucci sailed across the Atlantic, and discovered some part of Brazil, through which circumstance, and the difficulty of attaining historical accuracy on such matters, he has been by some considered as the discoverer of America, which has been named after him. But his chief merit, whereby he was so honoured, seems to have been that he first gave the world anything like a circumstantial account of the earliest voyages to America.

Now it is manifestly impossible that such a train of extraordinary events, all occurring within a period of about fifteen years, could fail to produce a powerful effect on the nations of Europe. A new train of ideas was opened up; the feudal and baronial customs of England and other countries, which had been for some time on the decline, received a further blow by these discoveries; since the mercantile classes found new channels, in which to dispose of the manufactures of their own country, and to receive the produce of the newly-found lands in return; while the manufacturer and artisan found a new field for their labour, in providing for the foreign markets. Hence it was by such events that that large section of the community, which is known as the "middle classes," attained an influence in the state, which they did not before possess.

It must not however be supposed that this eventful change in European history was productive of unalloyed good; for men, especially when ignorant and excited, will too often abuse the good gifts which Providence bestows upon them; and the love of wealth which, when kept within judicious bounds, is one of the elements of a nation's prosperity, seems to be a curse as soon as it becomes a passion. The Spaniards, when they had seen the natural wealth of the Peruvian and Mexican countries which they discovered, gave vent to their insatiable avarice, and gained possession of vast treasures by the commission of atrocities, at which justice and humanity recoil. But yet did it not conduce to the welfare of Spain: for the acquisition of so much gold without giving commodities in return, engendered a spirit of indolence, which sapped the foundation of the nation's prosperity, and afforded to the rest of Europe a practical illustration of the lesson, that "Industry is better than gold."

Early in the sixteenth century, Cortes had visited and conquered Mexico. In 1512 Ponce de Leon led his followers out to the New World, with the hope of discovering the far-famed Fountain of Youth, and first visited the tract now called Florida, which was so named in consequence of the beautiful appearance of the country. The Portuguese had, a few years before this, sent out an expedition to explore a north-west passage to India, under Cortereal, which being wrecked, his brother Gaspard went out in search of him, and was lost also in the sea at the entry of the St. Lawrence river, which was for some time after called "the Gulf of the brothers." This sea, afterwards called Hudson's bay, they thought to be between Africa and America. But the Portuguese had now acquired for themselves a vast extent of territory in South America, now called Brazil; in proceeding in an expedition to which parts the celebrated Diaz lost his life, between Brazil and the Cape of Good Hope. The Portuguese owned at this time almost the whole extent of the East Indies and the west of Africa, but all these, with one or two exceptions, they have now irrecoverably lost.

In the year 1527 we read of the English making an attempt to get to Cathay by the North Pole. Soon after this we find Drake and Frobisher, celebrated English seamen, advancing the nautical art and a knowledge of the world; the two being naturally coeval with each other. About this time Drake first sailed into the Pacific Ocean, and discovered the tract of country now known as California. From this place he steered on westward, and arrived at the Spice Islands, and there began a lucrative commerce. He visited in his passage homewards Sierra Leone, and arrived in England in 1580, having been absent nearly three years. Drake was the first Englishman who circumnavigated the globe. Cavendish, another spirited adventurer, soon after pursued a similar route.

About this time, Newfoundland was visited for commerce and fishery; and the tract of country now called Virginia, was so named in honour of queen Elizabeth.

In the year 1542 we begin to hear of Japan, which was first visited by the Portuguese: and about the year 1563 Juan Fernandez discovered the island named after himself on the western side of South America. This island is celebrated as the abode of Alexander Selkirk, a shipwrecked mariner; found here, after four years' solitary residence, by Captain Dampier, at the end of the seventeenth century. Selkirk was the original of the celebrated novel, called "Robinson Crusoe." Sir Walter Raleigh, likewise made some figure in nautical affairs about the end of the sixteenth century.

In the year 1553 Sebastian Cabot, the son of the former Cabot, and who had been named by Edward the Sixth, "grand pilot of England," was called upon for his advice and assistance in an expedition to discover a passage to China, by way of the north-western seas. This expedition he did not accompany, owing to his advanced age. The expedition was never more heard of: it perished miserably, as alluded to by the poet:—

> Miserable they,
> Who, here entangled in the gathering ice,
> Take their last look of the descending sun;
> While full of death, and fierce with ten-fold frost,
> The long long night, incumbent o'er their heads,
> Falls horrible. Such was the Briton's fate,
> As with *first* prow (what have not Britons dared!)
> He for the passage sought, attempted since
> So much in vain.——

The general objects of the northern expeditions of late years, have been to reach the pole, and to find a passage to the left to China. For about three hundred years past, this has been an object with all the chief nautical nations of Europe.

Though the Spaniards, after having been enervated by wealth, did very little towards fresh geographical discoveries and nautical science, yet we read of their attempting, under Gomez, to get to the Spice Islands by this route: this was in the year 1524. During the reign of Henry the Eighth, several attempts were made by the English. Expeditions were afterwards fitted out under Davis, Baffin, Hudson, and many others, which answered not the end in view; but increased the geographical knowledge of the northern continent of America; the various places of which have been named from the early discoverers.

The end of Hudson was lamentable. He had been sent out by the London merchants in the year 1608; and having discovered and explored the great inland sea, called after him "Hudson's Bay," he was left by his mutinous crew to perish on its banks. The company, afterwards known as the Hudson's Bay Company, for trading in furs, was not formed till the year 1668.

This spirit of enterprise and action in the north existed in England until about the year 1616, when it declined; nor was it revived until the year 1676, when Captain Wood was sent out by the Admiralty.

In the year 1594, the United Provinces of Holland having become independent of the crown of Spain, made an attempt to explore the north-western regions of our hemisphere: and, as they were a great trading people, they hoped, in common with the English, to shorten the passage to India. Many attempts had been made to have communication with India through Russia and Persia; but this was found more expensive than the ancient mode of carriage, by the Arabian merchants. Hence their desire for a north-west passage. Denmark sent out an expedition for this purpose about the year 1619; and a solitary attempt was made by some enterprising English individuals, in the year 1631.

The commercial spirit of the Dutch soon raised them to be an important naval power. After the discovery of the passage to India round the Cape of Good Hope, the Dutch entered with energy into the establishment of mercantile arrangements with the countries of the east; and in so doing, they necessarily had to pay great attention to the construction and general fitting up of their shipping. As they acquired power, so did their ambition increase; and they divided their naval exploits between trading to the east, and humbling the Spaniards in the west. In 1639 the celebrated Dutch Admiral Van Tromp, with a fleet of only eighteen vessels, forced a Spanish fleet of eighty-nine sail to retire discomfited. At and about the beginning of the seventeenth century, the Dutch had great power and possessions in the East Indies, and on the coast of Africa; which has been since greatly interfered with by the French and English. New Zealand was discovered by them in

1642, during an expedition under Tasman, a navigator sent out by Van Diemen, governor of the Dutch possessions in the East. Tasman's first discovery, after setting sail from Batavia, was the land now called Van Diemen's land, which is at the south of Australia, which was likewise discovered by the Dutch.

About this time, 1618, expeditions were fitted out from England for African discovery. The French took up the subject about eight years after; after which it slept till the year 1720, when the subject was revived and pursued with ardour by Park, Denham, Clapperton, &c., in times more contiguous to our own.

During the sixteenth century it is remarked that, as the zeal of the Spanish navigators declined, that of Russia increased. Moreover, the Russians have, on many occasions, shown themselves alert to advance the cause of maritime and geographical knowledge. By them was decided the important question, that Asia and America were separated by a breadth of ocean, now known by the name of Behring's strait. This question was much discussed in Holland, when Peter the Great dwelt there in 1717. The more pressing cares of government prevented him from giving attention to this question; but in his last illness, he enjoined its fulfilment upon his successor. The Empress Catherine, in the year 1735, originated the expedition; and the object of it was effected in 1730, by Captain Behring, whose name has been given to the passage. The Russians entered upon another expedition in 1741, to explore towards the north-east, and meet the more western nations of Europe, in their advances to the north-west; and at the same time another expedition went southward to Japan.

The French expedition under Cartier, in 1534, had conquered and subjected to the crown of France, all the countries round the St. Lawrence, in North America; all which were taken by the English, about the year 1763. In consequence of the success of the French in their voyages of discovery, while occupying Canada, the English were incited to send Commodore Byron, in the year 1764, on a voyage of discovery to America; and soon after, about 1783, France, with a like spirit of emulation, despatched an expedition for a similar purpose, under La Pérouse.

In the year 1773, north-west discovery was again pursued under the conduct of Captain Phipps, who got to about 81° north latitude. In 1776 Captain Cook was sent out to sail into the Pacific, and thence into the Atlantic. He performed several voyages, the tracks of which are usually laid down on full-sized globes and maps. After Cook, the north-west coasts of America were visited at different periods by Meares, Vancouver, and Kotzebue; and though the limit of discovery was not then extended beyond Icy Cape, the shores were more minutely examined, and an useful commerce established with the natives. Captain Cook completed the survey of Australia; and since his time no material discoveries have been made in the South Seas.

Captain Bligh, in the Bounty, sailed into the Pacific ocean, in the year 1788: upon which occasion a mutiny took place. Many of the men remained behind in the beautiful islands of those seas; who were subsequently seen by Captain Edwards, of the Pandora, in 1791: and in 1808, Adams, one of the last of the mutineers, was seen at Pitcairn's Island, by Captain Folger; and by Captain Staines in 1814.

Attempts have often been made by the British nation, to complete the subject of northern discovery. An expedition was fitted out for this purpose at the beginning of the last century, under Knight and Barlow; but it never returned. A vessel commanded by Captain Scroggs was sent out to look after it about 1720; but it was not until fifty years after that the wrecks of the vessels were found upon Marble Island. The expedition was renewed in 1741, under Middleton; and subsequently several attempts were made to co-operate with Captain Cook in his endeavours to seek a north-west passage. After this, this part of maritime discovery was suspended until 1818; when Parry, Franklin, and Ross, began to make somewhat more extensive advances in the abodes of eternal winter.

Sir John Franklin, accompanied by Dr. Richardson, visited these parts upon two occasions; in 1820 and 1825. In May, 1825, Captain Beechey was sent out by government, in the Blossom, to Behring's strait, to assist and co-operate with Franklin and Parry, if these should succeed in passing along to the north-west, and discovering the long sought passage. While waiting between Asia and America, he surveyed the coasts, &c., with great care and minuteness. Parties from the Blossom passed over-land to the east, and came within 150 miles of the advanced parties of those who were proceeding westward. Beechey arrived again in England in October, 1828, and found that Franklin had returned about fourteen months before him.

The Russians have likewise endeavoured to promote maritime discovery about, and to the north of, Nova Zembla. Under Kotzebue, in 1816, they explored northward of Behring's strait; and they have always afforded every facility in their power towards the discovery of the north-west passage.

SHIPS.

We need not enter into the form, and other details, of modern shipping, as the reader will find an extensive and minute account, by referring to the 69th, 103rd, and 106th numbers of this work: but we cannot refrain from presenting our readers with the following details of the origin of the Life-Boat, and the uses to which it is applied. The Life-Boat forms the subject of the frontispiece of this paper.

So long as life is subject to those vicissitudes and accidents which inevitably threaten it, so long will there be exercise for the developement of humane and benevolent contrivances for preventing, or at least alleviating, distress, in whatever form it may be presented.

The vast and briny ocean is not the least among the sources of human destruction, and has presented, in more ways than one, a wide field for human perseverance. When a "rough sea" is met with far from land, the danger to a ship is not so great as when it occurs near shore; for in the latter case there is imminent danger of her being driven upon shoals, or against rocks, by which the stoutest vessels are shattered.

In such cases, the peril in which the poor mariners are placed is extreme;—often so near the shore that spectators can see the gradual destruction of both ship and men, without possessing the power to render assistance; since any common form of boat dares not venture from the shore to the distressed vessel to afford relief.

A circumstance such as this occurred in September, 1789, when the *Adventure* was stranded on the Herd Sand of South Shields, in the midst of tremendous breakers. The shore was lined by spectators, who saw the mariners drop one by one from the rigging into the waves; and all were lost.

A meeting of the inhabitants was called shortly afterwards, when a premium was offered for the construction of such a boat, as should be able to stand against any tempest, so as to afford a means for sending assistance from the shore to a ship in distress. Mr. Greathead gained the premium, and in 1790 a boat constructed by him was launched, and was found to possess almost every requisite. Its mode of construction was such that it was almost impossible to be upset. The length was thirty feet, breadth ten feet, and depth about three feet. It was exactly alike at both ends, so that it could be rowed either way; and the ends curled upwards to a great height, in consequence of the keel being very deeply convex from end to end. The cross section was likewise a portion of a circle. The sides were cased with a layer of cork, twenty-one feet long, sixteen inches wide, and four inches thick; which were secured with slips of copper: and a somewhat similar layer of cork lined the inside of the sides, the quantity altogether being seven hundred weight. There was provision for ten oars, besides an oar at each end to act as rudder. The internal shallowness of the boat, the elevated position of the ends, and the bulk of cork, left such a small amount of room, that when quite full of water, its stability was scarcely affected.

The efficacy of the construction was put to continual and severe tests off the Yorkshire coast, and gave most complete satisfaction. On one occasion the boat reached a ship in a tremendous gale, brought away the crew, and came safely to shore, crammed with seamen, and completely full of water: this would be almost incredible, were it not that the whole of the cork was above high-water line, and therefore gave it an extraordinary buoyancy.

On another occasion, when the awful appearance of the ocean quailed the hearts of even those who had been accustomed to manage the life-boat, Mr. Greathead himself jumped into the boat, and thereby infused a new ardour into the men; they reached a wrecked vessel, picked the shivering and exhausted mariners from the shrouds to which they hung, and brought them all safely on shore.

1200*l.* from Parliament, 100 guineas from Lloyd's, 100 guineas from the Trinity-house, 50 guineas from the Society of Arts, and a diamond ring from the Emperor of Russia, were some of the rewards which Mr. G. received for his ingenuity.

Various other contrivances for the same object, more or less similar to the above, have been adopted; but at these we can only glance. A plan of Captain Gordon was, to have an assemblage of strips of cork fastened round the outsides of every boat attached to a ship; so that, in case of wreck, the men could take to the boat, and preserve themselves above water by means of the buoyancy which the cork gave to the boat.

Another contrivance, by Mr. Grant, was, to have a thirty-six gallon cask, with some iron ballast, fixed on a wooden bed, and lashed to the cask, and ropes round it for men to hold by. When the hole of the cask was well bunged, it was found that ten men could be supported by it without inconvenience. Such casks it was proposed to have kept on board ship. In other cases, corks, bladders, rafts, and various contrivances have been recommended as means of escape from a ship to the shore.

But a contrivance has been adopted, by means of which a rope can be thrown from the shore to a ship; so as to establish a communication between them. This is the method of Captain Manby, which was perfected some years ago. A shot, shaped somewhat like a pear, was fastened, through the intervention of plaited hide, to a rope which was long enough to reach from the shore to a ship in distress. On the shore was a small mortar, with a provision for shielding the touch-hole from rain.

The mortar was loaded, and the ball inserted; the piece was then fired, and the ball left it with the accustomed velocity, uncoiling the rope, (which lay in a coil or "faker" on the ground by the side of the mortar,) and passing over the ship; so that, in falling, the ball, to which some barbed hooks were attached, would cling to some parts of the rigging, so as to enable the seamen to seize the rope, and so to draw to the ship, boats, hammocks, cots, rafts, or any other contrivance which might be at hand to effect their escape to shore.

It was found that neither iron chains, nor hempen ropes, could, when attached to the ball, bear the sudden expulsion of the latter from the mortar without breaking; but plaited hide was found to answer that object. When the assistance had to be rendered at night, and the ship was not visible from shore, a ball, containing combustible matter, was shot up into the air: it had a lighted fusee attached to it, which was so regulated as to ignite the combustibles at an elevation of about 300 yards. By these means, a splendid light was produced, by which the persons on shore could see the position of the ship, and could place two white rods in a right line with the ship, as a guide. A ball was then fired; but, instead of being solid, it was a shell, filled with combustibles, and having four holes, through which a brilliant stream of light rushed as the shell passed through the air: this enabled the seamen to perceive the rope in its passage, so as to make the necessary exertions towards their own preservation. This very elaborate and ingenious invention of Captain Manby, drew the particular attention both of the House of Commons and of the Navy board.

MODERN PRACTICE OF NAVIGATION.

The nautical art is usually divided into two parts—*Seamanship*, and *Navigation Proper*. The first branch is to be learnt only on board; and comprises all those details which relate to the management of the ship, apart from guiding its course, which is termed *Navigation Proper*.

In this branch of our subject, there are *three* things in particular, which it is the object of Navigation Proper to ascertain:—1. Rate of ship's going, and distance gone.—2. Direction in which the ship is going, or her course.—3. Where the ship is.

1. The rate of the ship's going, and her distance gone, are ascertained by the LOG. The inventor of this instrument is not known. It is first mentioned by Purchas in 1607, as commonly used: it is a quadrantal piece of wood, about 6 inches radius, and a quarter of an inch thick, loaded with lead at its arc, in order to make it stand upright in the water. It is called the *Log-ship*, and has a line fastened to it, about 120 fathoms long, called the *Log-line*, which is divided into spaces called *knots*, and is wound on a reel, from which it runs off freely when used. With this is used a half-minute glass. The operation of using these instruments, is called *Heaving the log*.

When the log is thrown overboard, it remains stationary in the water; and the number of knots marked on the line by pieces of red rag, which pass over the side of the vessel, while the glass is running, shows how many knots, or nautical miles, the vessel is sailing per hour.

The knots are nearly 51 feet on the line, apart from each other; and as 50 ft. 8 in. is the same part of a nautical mile, that a half minute is of an hour; it is clear that the number of knots observed, shows the rate of the ship's going. The log is thrown over on the lee-side of the ship, (that is the side *away* from the wind,) and the first knot is about twelve fathoms* from the log, in order to allow the log to settle and get out of the eddy of the ship's wake. When the red rag at the first knot passes over the side of the vessel, the glass is allowed to run; and the knots are then counted as they pass over, till the sand has run out. The log is heaved every one or two hours.

Having thus ascertained the *rate* of the ship's going, the *distance gone* is known by multiplying these knots, or miles, by the hours sailed.

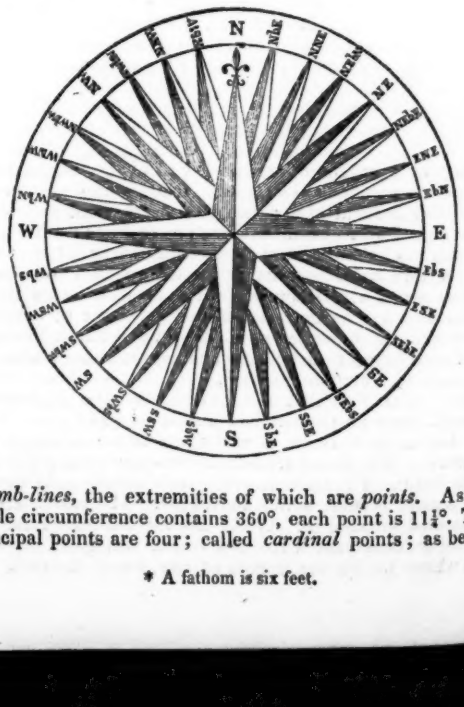
II. The course of the ship is ascertained by the COMPASS. The attraction of the loadstone for iron, was known in very early times; but the polarity of the needle does not seem to have been discovered until the end of the twelfth century. The compass was first used on land; and in progress of time, applied to guide ships on the ocean.

The subsequent account of the compass, is derived, in an abridged form, from TOMLINSON'S *Manual of Natural Philosophy;* to which work we likewise owe the figures illustrative of the subject.

The principle of the compass is, that a magnetic needle such as is here shown, is suspended, for land purposes, *over* the card on which the points of the compass are delineated.

The annexed cut shows the polarity of the needle, which is balanced on a point C, at the top of the stand BA. The point C of the magnet, is the *neutral* line, and is equidistant from the poles N and S.

The accompanying figure represents the card of the compass, and shows the visible horizon of any place. It is circular, and divided into thirty-two parts by lines called

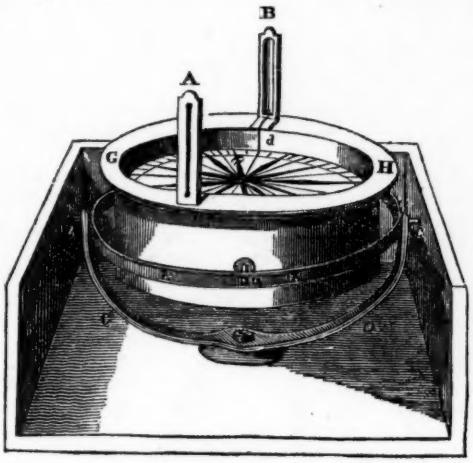


rhumb-lines, the extremities of which are *points*. As the whole circumference contains 360°, each point is 11¼°. The principal points are four; called *cardinal* points; as being

* A fathom is six feet.

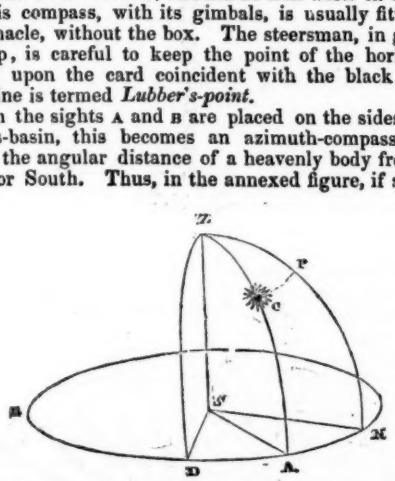
those on which the others *hinge* or depend. The North cardinal point has a fleur-de-lis. A needle suspended at the centre of the card, and enclosed in a box, is used in surveying.

But the magnetic needle of a ship's compass, is placed *under* the card, along the North and South line; so that the card obeys all the motions of the needle. The annexed representation will serve to illustrate the two sorts of compasses used on board ship,—the Steering and Azimuth compasses. The steering-compass is without the sights A and B.



In the figure, the nearest side of the square box is represented as wanting, in order to show the interior arrangement. The steering-compass is often called the *Binnacle-compass;* because it is contained on board in a large wooden case, furnished with lights at night, and an hour-glass; and it is placed in front of the helmsman at the wheel. This case is called the *binnacle*, and has no iron work in or about it. This compass, with its gimbals, is usually fitted into the binnacle, without the box. The steersman, in guiding the ship, is careful to keep the point of the horizon as marked upon the card coincident with the black line *d*, which line is termed *Lubber's-point.*

When the sights A and B are placed on the sides of the compass-basin, this becomes an azimuth-compass. Azimuth is the angular distance of a heavenly body from the North or South. Thus, in the annexed figure, if s be the

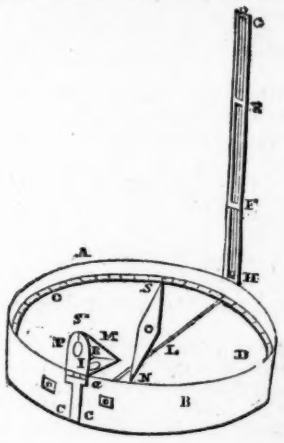


observer, Z his zenith or point overhead, Z N his meridian, N A B his horizon, then Z A will be the azimuth circle passing through a heavenly body C. D is the east point of the horizon. The arc of the horizon, N A, or C P above, measured in degrees, is the azimuth of the heavenly body C, and A D is its amplitude, or distance in degrees from the East or West points of the horizon. The use of observing the amplitude or azimuth of the sun, or other heavenly body, is to ascertain the *Variation of the compass*, which is different in different parts of the world; there being but few places, comparatively, where the needle points truly North and South; and it is evident, that if this deviation were not constantly noted, the compass would be almost useless.

Let us now recur to the figure of the compass going before. The sights are placed vertically on the rim G H of the basin. The sight A, which the observer looks through, is a piece of brass with a narrow slit. The other sight B, is directed towards the object; down which slit passes a fine wire or horse-hair. There is a vertical line going down from B which marks the degree on the rim of the card, when the card is stopped in an observation by a small lever connected with it. This compass is held in a square box. The compass-basin is supported by a semicircle of brass C D, passing below the basin, and screwed firmly to the bottom of the box: and it is suspended horizontally by two opposite pivots, one of which is seen at *a*, passing from its sides into a hoop of brass E F, which hoop, by means of pivots from two extreme points *b c*, is connected with, and rests from the extremities of the semicircle C D. These hoops are termed *gimbals*, and their use is to keep the compass horizontal, however the ship may be tossed about in the sea. The compass-basin is covered with a glass to prevent the card from being agitated by the air.

When, in looking through the sight A, the sun, or a star, is seen to be bisected by the wire at B, the card is stopped by a handle at the side of the basin, and its angular distance from the North or South, or from the East or West, as shown by the card, is taken; the former angle being termed the magnetic azimuth,—the latter, the magnetic amplitude. From these are computed the true azimuth and amplitude; and thence, the amount of the variation of the compass.

An azimuth-compass of an elegant, cheaper, and more portable character than the foregoing, has been contrived by the late Captain Kater. We here give a representation of it. A B is a cylindrical brass box, one inch deep, with a



glass cover. This box contains the compass-card C D, which is five inches in diameter, and the needle N S, delicately poised on an agate cap. The needle is attached to a disk of talc, round the rim of which is laid a ring of card, graduated to half-degrees. A slanting piece of ivory is seen within the box, just projecting over the margin of the graduated circumference of the card; and an index-line is marked on the ivory for reading off the divisions on the card. A brass sight-frame G H is placed exactly at the opposite side of the box; it is five inches in length. A shorter frame E F, two inches long, slides up and down G H; and contains the segment of a glass cylinder. When the sun shines upon this lens at E F, its rays are collected into a linear focus; and the line of light, being cast upon the index-line of the ivory projection, may be seen at the same time with the degrees on the card. The frame G H can be bent down by a hinge at H, when the instrument is not in use. It then presses upon a lever L which raises up the needle N S, and prevents it from getting damaged. The sight for the observer's eye is one inch in height from the hinge *a* to its upper part; but it may be raised higher by means of an upright piece which slides between two grooves in the side of the box, as shown at *c c*. This upright piece has a vertical slit s', which terminates in a hole I, with a convex lens. There is also a horizontal plane below E, fixed beneath the hole I; in which plane there is also a convex lens, attached to which at an angle of 45° is a mirror, E, on the inner side of M, by means of which, and the lenses, the observer looking through the hole at I, sees the degrees on the card by reflection, reversed and magnified. The figures expressing the degrees, are therefore printed in reverse, so as to be read in their proper position, when seen through the lenses.

In making an observation with this instrument, the frame G H is raised and directed towards the luminary. Then the cylindrical lens E F, is slid up or down, till the linear focus of the sun's light falls upon the ivory index. This is viewed through P; and when the card is steady, the degrees and parts shown by the index-line below I, which is bisected by

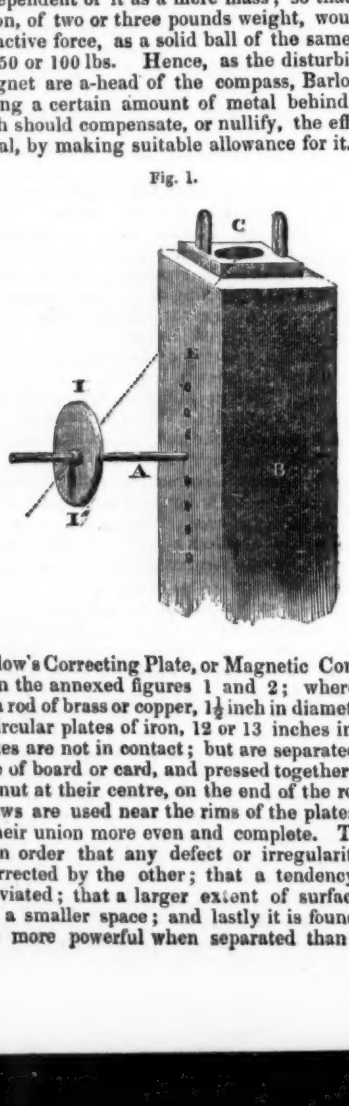
the solar line of light cast by the lens E F, are read off, which will give the magnetic azimuth. When an observation is made for the azimuth, the heavenly body observed should not be much above the horizon; and if it be the sun, the observation is made most safely, when the sun's disk is bisected by the horizon.

This compass may be used in surveying. For this purpose, the lens E F, is moved out of the way to the top of the frame G H; and then the horse-hair, or wire, passing down G H, is distinctly seen. The hair or wire, being viewed through the slit s′, is made to bisect an object seen by direct vision, at the moment when its bearing by the card is viewed by reflection. This hair, or wire, is not used in observations of the sun; but must be applied, when the amplitude or azimuth of a star is taken; and the lens on G H is not used in terrestrial observations. The sight at P may be thrown back by means of the hinge at *a*, and the degrees read off with the naked eye.

But the compass,—the providential and excellent aid of the mariner, was discovered, in progress of time to err, even from the *magnetic* meridian. With how much less certainty then could the mariner know the geographical meridian, when out upon the boundless ocean! We refer to the local attraction of the compass-needle in consequence of the masses of iron on board-ship; whereby the needle is drawn more or less from the magnetic meridian, according to the situation of the disturbing causes with respect to the needle. This effect is called *the aberration of the needle*; and is of large amount in ships of war; where the guns, shots, water-tanks, and frame-work of the vessel, are all made of iron. But the real cause of this evil was not suspected until the year 1794, when it was first cleared up by Mr. Downie, master of his Majesty's ship Glory; and Professor Barlow instituted the means for remedying the evil; which means, we will endeavour briefly to give an idea of.

Among many useful and curious facts, which Barlow elicited in the course of his experiments, he ascertained, that the magnetic power resides entirely on the surface of a body and is independent of it as a mere mass; so that a hollow shell of iron, of two or three pounds weight, would have as much attractive force, as a solid ball of the same diameter, weighing 50 or 100 lbs. Hence, as the disturbing causes of the magnet are a-head of the compass, Barlow thought of arranging a certain amount of metal behind the compass, which should compensate, or nullify, the effect of the ship's metal, by making suitable allowance for it.

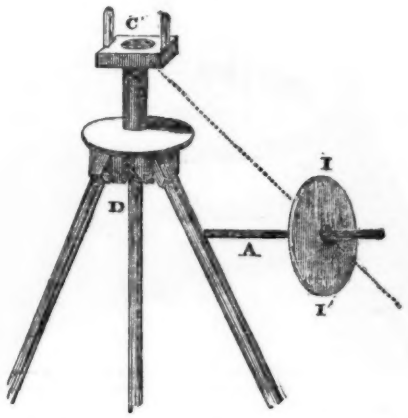
Fig. 1.



Mr. Barlow's Correcting Plate, or Magnetic Compensator is shown in the annexed figures 1 and 2; where in both cases A is a rod of brass or copper, 1½ inch in diameter, and II′ two thin circular plates of iron, 12 or 13 inches in breadth. These plates are not in contact; but are separated by a circular piece of board or card, and pressed together by means of a brass nut at their centre, on the end of the rod. Other small screws are used near the rims of the plates, in order to make their union more even and complete. Two plates are used, in order that any defect or irregularity in one may be corrected by the other; that a tendency to warp may be obviated; that a larger extent of surface may be gained in a smaller space; and lastly it is found that the plates are more powerful when separated than when in contact.

In fig. 1, B is a box moveable on an axis, in order that it may be turned round in any direction, as the head of the ship is turned round at sea. This box is used on land, and has no iron connected with it. On the side E are various holes for the reception and adjustment of the rod A. An azimuth-compass C, is fixed on the top. The apparatus D, fig. 2, is used on board-ship, to support the same azimuth-compass C′; which sort of compass is chiefly employed in these observations, not only as being more portable, but as enabling the observers to measure arcs of the horizon. This and the binnacle-compass must, however, agree in their observations.

Fig. 2.



The manner of using this apparatus is as follows. When a ship, being about to proceed on a voyage, has received all its metal on board, the variation of the compass C′ is carefully noted as the ship's head is swung round to the principal (say, the four cardinal and four secondary) points of the horizon. The box B, with this compass on the top, is then taken on shore, and set down where it will be free from all metallic attraction. The object of the observer on shore is, by the adjustment of the plate I I′, on the side of the box E, as this box is turned round to the principal points of the horizon, (those mentioned before), to produce the same, or similar, irregularities in the needle of the compass C, on the box B, as were occasioned to the needle of this compass when on board, by the masses of iron in the ship. A little practice will soon enable any one so to adjust the plate, as to obtain the object in view with tolerable accuracy. This having been effected, the distance from the centre of the plate to the pivot on which the needle turns, is carefully noted; together with the angle which the plate makes with a vertical plane. Whenever the plate is used on board, it must be fixed to one of the legs of the tripod D, (which usually supports the azimuth-compass during an observation,) at the same distance from the centre of the needle at C′, and at the same angle with the vertical, as when inserted in the side E, of the box B.

Now, as the plate was made to produce as much error as all the iron on board, when the plate is used on board, the error is consequently *doubled*. It is, of course, understood that, whenever the azimuth-compass is used, it must be placed in the position where it was just before taking the box B on shore; as the needle is variously affected in different parts of the vessel.

The action of the metal on board is to *increase* or to *diminish* the true variation, according as the ship lies at the time; and, as the plate doubles the error of the variation, allowance is made, + or —, accordingly.

In process of time it came to be observed that the rate of going of the chronometers on board ship was more or less affected by the quantity of metal on board, or rather by partial masses near the chronometers: owing to which, the difficulty of truly determining the longitude by these time-keepers was made more decided. The evil here spoken of, was at first imputed to the motion of the vessel on the seas, until, in the year 1818, Mr. G. Fisher, who accompanied Captain Buchan in his voyage to the north seas, observed that the chronometers went differently on shore from what they did when they were in the vessel, and subject to the metallic influence on board. This branch of the subject likewise engaged Barlow's attention; and the

remedy suggested by him is dependent on the same principles as those applied in the former case.

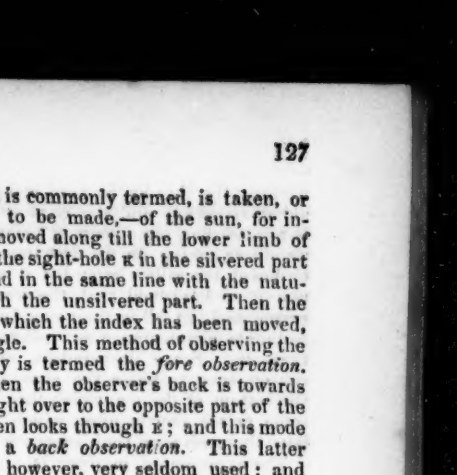
CHARTS of different places on the earth's surface are necessary for the mariner. A chart is a *nautical map*, containing, besides general geography, a detailed account of the coasts and shores, rocks, sand-banks, &c., &c. A globe is the most natural representation of the earth; but this is usually of necessity small, and cannot give places in detail, so well as maps. But as much of the convex surface of the earth cannot be laid down on a plane surface, and as the *bearing* of a place is of more importance to the navigator than its apparent size, charts are drawn with the meridians parallel to each other, so that the northern and southern parts of such a map are swelled out and distorted beyond nature; but the bearing of places thus laid down is accurately estimated at a glance. Hence, as far as appearance goes, the nearer a place is to the equator, the truer is its apparent comparative size in nature; and the nearer we get to the poles, the more magnified is the representation.

III. By the log and the compass, the latitude and longitude of the ship may be inferred by calculation; the latitude and longitude at departure being known. The ship's progress is set down for twenty-four hours on the log-board or slate, and is transferred to the log-book, and at twelve o'clock every day the account is made up. The distance run by the log, in the direction as shown by the compass, gives the difference of latitude and longitude *by account*, which is called the *dead reckoning*: but as this method is apt to be fallacious, except in short cuts, astronomical science furnishes means for correcting the latitude and longitude by account *by observation*. The instrument used for this purpose is the quadrant, or sextant, or both.

The use of this instrument was adverted to in a former article on Navigation, No. 417, p. 252, of this work. The modern quadrant is an improvement upon the ancient astrolabe; and the sextant is an improvement upon the quadrant. Moreover the reflecting circle is an improvement upon the sextant.

The quadrant is more properly termed an *octant*, because its arc embraces the *eighth* part of a circle, though we are thereby enabled to measure a quadrantal arc, or the fourth of a circle, = 90°. The *sextant*, however, has an arc to the extent of one *sixth* of a circle; but we are enabled by its means to measure an arc of 120°, or the third part of a circle. The reflecting circle, a still more accurate instrument than the foregoing, has an entire circle graduated, and enables us to measure larger arcs, than we could do with the before-mentioned instruments.

The principle of these three comparatively modern instruments being the same, we proceed to illustrate their nature and use, by reference to the accompanying figure of the QUADRANT.



A is the frame-work of the quadrant, and affords convenience for grasping it during observations on board. B is the index, which turns on the centre of the circle, of which the divided limb D is a part or arc. The index B carries the index-glass I perpendicular to the plane of the index, and in a line with O on the vernier scale C. G is the fore horizon-glass half silvered, and so placed by means of its adjustment as to be parallel to the index-glass, when O on the vernier is at O on the limb D. K is a sight hole, through which the horizon is seen through the unsilvered part of the glass at G. At H is a set of coloured glasses, by using one or more of which we may protect the eye from the direct rays of the sun. E F is the back horizon glass and sight. This glass is silvered at both ends, and in the middle there is a transparent slit, through which the horizon may be seen. At L is a nick to prevent the index from slipping off from the frame.

Now the sextant is an instrument rather more finished and nice in its construction than the foregoing: being more delicately graduated, and having telescopes for more perfect and distinct vision. The limb D of the quadrant is divided into 90 equal parts or degrees, which degrees are subdivided by means of the vernier C into minutes, 60 of which = 1 degree. But we more usually find that each of the degrees on the arc D is divided into thirds, each = 20′; each of which thirds is subdivided by the vernier into twentieths, or single minutes.

We cannot here conveniently enter into a consideration of the optical principle by which the arc D, though only the eighth part of a circle, affords us an estimate of angles to the extent of 90°. We proceed, therefore, to show the *use* of this instrument.

When "a sight," as it is commonly termed, is taken, or when an observation is to be made,—of the sun, for instance,—the index B is moved along till the lower limb of the sun is seen through the sight-hole K in the silvered part of the horizon-glass G, and in the same line with the natural horizon seen through the unsilvered part. Then the portion of the limb, over which the index has been moved, is the measure of the angle. This method of observing the altitude of a celestial body is termed the *fore observation*. The other method is when the observer's back is towards the object, and it is brought over to the opposite part of the horizon; the observer then looks through E; and this mode of observing is termed a *back observation*. This latter method of observing is, however, very seldom used; and is requisite only when the horizon under the object is broken by adjacent shores, or rendered indistinct by fogs, or any other impediments.

The principal use of the quadrant is then to make observations on board ship,—to find the altitude of the sun or of a star; that is, the angle which the elevation of such heavenly body makes with a horizontal line, or the boundary line of the sea, as seen in the distance. This angle can never be more than 90°, or the distance from the zenith to the horizon; and the altitude of the sun reaches this exten t only at mid-day, and in certain latitudes. The quadrant, therefore, whether with relation to the sun or a star, is always sufficient for taking the latitude; but, as a larger arc is often necessary to be measured in finding the longitude by lunar distances, we then have recourse to the sextant.

The sun coming upon the meridian, marks the close of one nautical day, and the beginning of another. At this time the reckonings for the past twenty four hours are made, which is termed *doing a day's work*. By an easy problem in nautical astronomy, the altitude of the sun at twelve o'clock, or its meridian altitude, enables the sailor to obtain the latitude of the place. But the latitude may also at other hours be taken by observation of the Polar star; but the meridian altitude of the sun has most advantages. There are about a dozen methods of finding the longitude, more or less easy on land: but none of them are available on ship-board, but two,—by *chronometers* and *lunar distances;* because no instrument can be conveniently used for observation of the heavenly bodies, but the quadrant and sextant; whose use is not impeded by the rocking of the vessel.

If an accurate chronometer, set to Greenwich time, be taken from London by a ship proceeding on its voyage, the difference of time, ascertained by the sun's coming upon the meridian at the time of taking the latitude, between the chronometer and the ship's time, gives the difference of longitude. If the difference of time be one hour, the difference of longitude is 15°—E., if the ship's time be *beyond* the chronometer, and W. if it be *behind* the chronometer. In practice, it is a matter of indifference whether the chronometer carried about on board-ship from place to place, really shows Greenwich time; so that its daily rate of going, and consequently, its accumulated error, be known at any stated moment. All that is required of the chronometer, therefore, is, that it should afford the means, (with or without correction,) of discovering the true time at Greenwich, at any particular moment.

The term *lunar distances* implies the distance of the Moon from the Sun, or from any of the fixed stars, which are in the neighbourhood of her path. As the moon is constantly changing her place, these distances are constantly varying. The distances at certain hours of every day in the year are given in the Nautical Almanac, which mariners take on board with them; and when these distances by measurement with the sextant are found to occur at different times from what the Almanac gives for their occurrence at Greenwich, the observed difference of time furnishes the difference of longitude, as specified before. This method of proceeding to find the longitude is termed "taking a lunar."

The question of the longitude has always been important, from the difficulty of ascertaining it with tolerable correctness. In 1714 Parliament offered a reward of 20,000*l.* for the discovery of a method for finding it within half a degree. Soon after, Harrison made a chronometer for this purpose, which varied only two minutes in four months, and received the reward. The act was repealed in 1828. The board of Longitude, the Nautical Almanac office, and the Royal Observatory, are devoted to this important problem.

Many of the old seamen are still prejudiced in favour of

working the ship by the dead reckoning, and look upon the aid of astronomy and the chronometer with suspicion. It is related that, some years ago, during the war with France, an officer having for the first time brought a chronometer on board, the sailors regarded it as an omen of ill luck; and it so happened that, the vessel being out cruising for prizes, nothing fell in their way for a long time, which unfortunate circumstance was referred to the luckless chronometer. Some desperadoes on board determined, in consequence, to pilfer the chronometer and consign it to the bottom of the sea, which they did; and, falling in with some prizes shortly after, which they took, they congratulated themselves on their escape from all malign influences.

The experienced mariner is also versed in many other things, which our limits will not allow us to dwell upon; such as the state of the sea in different parts of the world, the nature of tides and winds, the coasts, floatings of weeds, flights of birds, the state of the barometer, &c.

It is related, for instance, that the captain of a vessel, sitting in his cabin one day, while his ship was gliding along the Indian sea under full sail, observed the mercury of his barometer to sink rapidly and almost at once. Knowing that a partial vacuum in the atmosphere preceded a dreadful storm in the tropical climates, he immediately ordered all the sails to be furled. The order was obeyed with astonishment, as nothing seemed likely to interrupt the serenity of the skies; but, scarcely was the task completed, ere the most awful storm fell upon them that ever ship encountered; and they had only consulted their safety in the nick of time by taking in their canvass. It is further stated that several ships in the neighbourhood met the sudden storm without having prepared themselves to withstand its fury, and were consequently wrecked.

We will conclude this paper with a pleasing anecdote, related by Captain Basil Hall, to show the necessity for midshipmen and officers being ready and expert at observing, not only the sun, but the stars likewise, for their latitude; and these too in almost all weathers: for it often happens that the latitude and time on board ship cannot be obtained by a meridian altitude of the sun, in consequence of clouds; but it seldom happens that the sun and stars are all obscured long together.

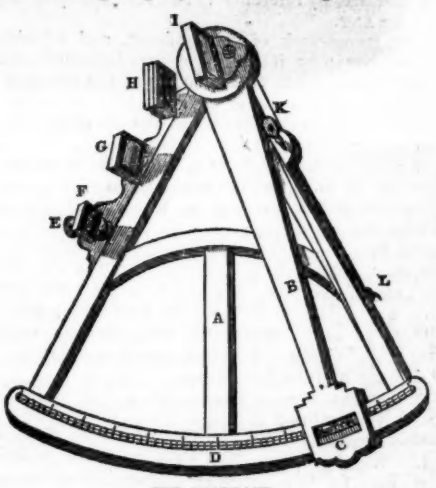
"We were running for the British Channel before a hard south-west gale, and it was of considerable importance that we should reach some port in England without delay, for we were not only charged with despatches, but were very short of provisions and water. The only chronometer I had on board happened not to be very good, and the sky had been completely overcast for more than a week before, that we could take no lunars. Thus I felt uncertain of my longitude, to the extent of a degree at least; and all who have tried the experiment, know what a nervous thing it is to run in for the land in the dark, and in stormy weather, when the ship's place is not correctly known. But I felt exceedingly loath to lose so magnificent a wind, before which we spun along at the rate of ten knots, under a reefed foresail and close-reefed maintopsail. As long as daylight lasted, I felt very confident and bold about the matter; but as night closed in, the doubts and difficulties of the Channel navigation crowded round my thoughts, and almost determined me to bring the ship to, and wait for the dawn. After poring for a long while over the chart, however, I satisfied myself that if, by any means, I could be sure of keeping in the latitude of 50¾°, or within ten or a dozen miles on either side of that parallel, I should have clear ground to run over for three degrees of longitude at least, greatly within which, I felt sure that the error of my chronometer must lie. But how was I to determine this point with any degree of certainty in such weather? The sky had not showed a patch of blue as large as my hand for several days, and though the sun had been seen through the clouds occasionally, we had not succeeded in catching a meridian observation.

"In this dilemma, I bethought me of the pole star, proverbially the mariner's friend, and having fixed my sextant by the cabin light at the angle about which I knew the latitude must give the altitude of the pole, I cast my boat-cloak over my shoulder and went on deck. There I stationed myself on the larboard side of the quarter-deck, with the instrument sheltered from the rain and spray under the cloak, and grasped in my right hand, while I kept my eye fixed on that part of the heavens in which I hoped, at some momentary opening, to detect the bright star of my night's fortunes. I had to wait more than an hour before there occurred anything like a chance; by which time my limbs had become cramped and stiffened by the constraint of one posture, while my eye ached and throbbed with its vain attempts to pierce the thick courses of clouds sweeping past.

"At last I did get sight of the star for three or four seconds, and though it glimmered so faintly through the mist that it could hardly have been identified as Polaris even by Sir James South himself, I knew, by its altitude, that it must be the object I was watching for. The horizon was but a shabby one, indistinctly seen in the dark, and hacked by the topping waves like the Sierra Morena. Nevertheless I succeeded in bringing the star in contact with the edge of the sea in the north, where, fortunately, there chanced at that moment to occur a faint gleam in the lower atmosphere. I ran below, read off the angle, computed the latitude, and found it not more than twenty miles from what I had expected, and quite enough to keep the ship safe for some hours' run. But as one insulated observation, made under such circumstances, could not be depended upon, I hastened on deck again, and presently—that is in less than half an hour—caught a second glimpse of my friendly lighthouse in the sky. The result agreed with that of the first observation within ten miles, and of course gave me greater confidence.

"Still as the night was dark, the horizon bad, and the observations both to the north, I could not rely upon them to the extent which was desirable, I may say indispensable, in running for the Channel in such a night, and at such a rate. So I cast about to fish for a star on the southern side of the zenith, and was rejoiced to find that a brilliant planet, either Jupiter or Saturn, I forget which, came to the meridian before midnight. On deck I went again, sextant in hand, and although I possessed no very certain means of telling 'the time at ship,' I watched for the planet, and caught it for a moment, not very far from the meridian, as I knew by the 'compass bearing.' With a flushed cheek, and hand trembling so that I could hardly hold the pencil, I worked out the latitude, and found it to differ from the mean of the two results by the pole-star rather less than twenty miles. A second cast at the planet, after it had passed the meridian a few minutes, gave, when properly reduced, a latitude which differed only five or six miles from the first. Putting all these observations together, I felt quite certain that the ship's path lay within the limits marked along the chart as a safe track, and, having given orders to shake out a reef, pressed forward as fast as masts, yards, and hull would bear.

"The ever-welcome dawn at length appeared, and not long afterwards I had the infinite satisfaction of discovering from the deck the well-known Lizard Point, with its two lighthouses, streaming with the night's rain, one above the other, and shining brightly in the morning sun."



THE QUADRANT.

In our next paper we shall conclude the subject of NAVIGATION, with an account of the origin, rise, and progress of Steam Navigation.

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